



Robotic Mining Competition Questions & Answers (new Q&As in red)

Competition Questions

Q. How do we know where in the excavation pit to dig?

- A. See Rule and Rubrics, Page 14, Diagram 2. CATERPILLAR MINING ARENA, Top-Down View. Lines in the diagram are designated by florescent chalk in the actual arena.

Technical Questions

Q: As part of our robot's design and control system, we have an embedded Linux computer. We have some concern about corrupting SD cards in the event that the e-stop is pulled and we want to mitigate this risk with a super capacitor that would discharge when the e-stop is flipped and provide just enough power for the Pi to recognize that it has lost power and shutdown safely. The motor, controllers, and all other boards would lose power immediately, we just want to tie up loose ends with respect to files and shutdown safely. It is one of our failure modes where the SD card becomes corrupted for an unnecessary e-stop pull right before a round. If this violates the concerns with safety procedures, this feature will be removed from the rover, but if not, we would love to have it.

- A: If the motors and all controllers are shut down immediately when the E-Stop button is depressed, then the capacitor for orderly shutdown of a Raspberry Pi is allowed.**

Q: Would you please provide some clarification regarding the attachment of targets / beacons. To what may these be attached?

- A: You may attach targets or beacons to the sieve and/or the collection trough at any point on the perimeter: front, sides or back.

Q. How would you like us to prove we aren't looking at the walls? We plan on using a Kinect which "sees" everything including the walls, so though we won't be using them in our positioning calculations, our rovers will still register them.

- A. See Rules and Rubrics, Page 9, 2) n. The walls of the Caterpillar Mining Arena shall not be used sensing by the robot to achieve autonomy. The team must explain to the inspection judges how their autonomous systems work and prove that the autonomy sensors do not see the walls. There are no walls on Mars and teams shall operate as closely as possible to a Mars scenario of operations. Integrity is expected of all team members and their faculty advisors. Failure to divulge the method of autonomy sensing shall result in disqualification from the competition.

Q. What kind of light will we be using in the field?

- A. High intensity discharge (HID) lights such as metal halide lights.

Safety Questions

Q: Page 5: Responsibilities of Participants: “Provide MSDS for any chemical, paint, and batteries that the team uses... “Does this rule apply to normal household items such as cleaners, caulking, or glue? If during contest our team needs to get a tube of grease for example from the local hardware store, does that mean that our team cannot bring it in or use it until we can provide an MSDS? OSHA’s Hazcom rules specifically exempt consumer household items provided the exposure is not greater than a consumer would normally experience in using these products.

A: No, implement OSHA regulations as follows: Provide MSDSs for any items that do not conform to the following to the Robotics Mining Competition Project Coordinator (you can usually obtain these sheets from the manufacturer’s web site or by calling the manufacturer directly). If the employee’s work area includes the area where the MSDSs can be obtained, then maintaining MSDSs on a computer would be in compliance. If the MSDSs can be accessed only out of the employee’s work area(s), then the employer would be out of compliance with paragraphs (g)(8) or (g)(9) [of the Hazard Communication Standard]. OSHA does not require that MSDSs be provided to purchasers of household consumer products when the products are used in the workplace in the same manner that a consumer would use them, i.e.; where the duration and frequency of use (and therefore exposure) is not greater than what the typical consumer would experience. This exemption in OSHA’s regulation is based, however, not upon the chemical manufacturer’s intended use of his product, but upon how it actually is used in the workplace. Employees who are required to work with hazardous chemicals in a manner that results in a duration and frequency of exposure greater than what a normal consumer would experience have a right to know about the properties of those hazardous chemicals (see <https://www.osha.gov/html/faq-hazcom.html#faq11>)

Q: Page 8: General Safety & Competition Safety. “Keep full control of the robot at all times ...” How would this apply if the robot is operated in the autonomous mode? Does this mean that a “kill switch” needs to be included part of the robot’s control software when it is in the autonomous mode of operation?

A: A kill switch is required on the robot and in the control software.

Q: Never work on the robot on an unstable surface. Including some examples such as folding chairs would be helpful.

A: Make sure the robot is properly secured if you must work underneath it. Never work on the robot on an unstable surface (Do not use chairs or jacks. Blocks, secured lock ramps that prevent the ‘bot from lowering or dropping without positive control may be used after being inspected/accepted by NASA Safety and/or the RoboPit Chief).

Q: “Welding, power tools, and chemical use are prohibited.” Given that that NASA will require participants wear safety glasses in the pit area (Page 11: Working in the Pit), a blanket prohibition on the use of power tools seems excessive. A better arrangement would be to restrict the use of power tools to a designated area such as the Bot Shop in the RoboPits tent. This would allow NASA personnel to more closely supervise their use.

A: See the following

- **Welding - will be performed in the ‘Bot shop area by ‘Bot Shop personnel.**
- **Portable Power Tools – teams will provide and use their own tools in the ‘Bot Shop.**

Q: What is meant by “chemical use”? Applying lubricant, cleaning up the robot or the work area with a common household cleaner such as 409, or using a hand cleaner? If there will be a prohibition on the use of chemicals, why will teams be required to provide MSDS’s “...for any chemicals, paint, and batteries, etc. that the team uses ...” as written on page 5 of the rules? A more descriptive phrase would be “The use chemicals is prohibited if their use is not compliance with their MSDS, or whose use can potentially cause a serious safety hazard to the user as well as to anyone in the immediate area.” Including some examples would also be helpful. Strong mineral acids such as hydrochloric acid. Chlorinated solvents such as trichloroethylene, Low boiling point solvents such MEK.

A: The use of chemicals is prohibited if their use is not compliance with their MSDS, or whose use can potentially cause a serious safety hazard to the user as well as to anyone in the immediate area [ex: strong mineral acids, hydrochloric acid, chlorinated solvents, trichloroethylene, low boiling point solvents such Methyl ethyl ketone (MEK)]. Coordinate ANY chemical use with the RoboPit Chief.

Q: Page 9: Soldering. Given the crowded conditions that exist in most pit stations, a designated area where participants can solder may be desirable.

A: Soldering work will be conducted in the designated soldering area.

Q: Page 9: Hand Tools. “Power tools will be operated by prototype shop personnel at the Bot Shop (in RoboPits tent).” One of the biggest challenges that teams face is ensuring their robots will be ready in time for their scheduled run times especially if their robots require any repairs or modifications. Will there be additional personnel at the BotShop to perform the needed repairs and modifications that require the use of power tools. Will additional space be allocated to park and work on the robots? Who will provide the power tools and the drill bits, saws, etc?

A: See below:

- Welding - will be performed in the 'Bot shop area by 'Bot Shop personnel.
- Portable Power Tools – teams will provide and use their own tool in the 'Bot Shop.

Q: Page 10: Stored Energy. “Ensure no one is working on the robot when it will be energized during repairs.” This rule needs to be expanded/explained in more detail. Because a robot is controlled by software, there is always the possibility of unexpected movement when it is initially powered on. Before our robot is powered up, everyone stays at least three feet away and there is always someone in a position to immediately press the emergency stop button if anything goes awry. “Always de-energize the robot before working on it by unplugging the batteries” For the past three years our robot was designed so that two switches had to be engaged in order for the robot to operate: the main power switch and the run enable switch. The emergency stop button removed power from buses that supplied power to the computers and motors immobilizing the robot. While unplugging the batteries will completely isolate them from the robot, that will cause some difficulty for most teams because the batteries on their robots are in a sealed enclosure. A better approach is to use a battery disconnect switch which can be mounted on the enclosure and connected in series with the battery such as the one shown in Fig. 1. Battery Disconnect Switch. Battery Disconnect.

A: Ensure the following:

- On initially power up, keep all personnel 1 meter away from the robot with a safety person ready to press the emergency stop button in the event of an unplanned movement by the robot.
- Disconnect any external electric power source
- Disconnect any internal power source (use a battery disconnect switch or equal)
- De-energize the robot before working on it
- Open the main circuit breaker (“re-set” lever is released).
- The computer, laptop, iPad/Slate, CPU, 'Bot Brain can remain powered on

Miscellaneous Energy Sources:

- Relieve any compressed or stretched springs or tubing.
- Secure and/or provide temporary support to all raised robot arms or devices that could drop down to a lower position on the robot before working in the areas immediately below the raised items.

Q: Page 10 and 11: Electrical Safety. The last two of the following statements are very confusing And contradictory. The third and fourth statements effectively prohibit the use of any extension cords in the pits. Under what conditions is the use of electrical extension cords

permissible in the pit? Avoid the following electrical setups to prevent overloading: Power strip plugged into another power strip. ('Daisy Chaining') Extension cord plugged into another extension cord.

A: Not at all. A power strip is not an extension cord; therefore you cannot connect them in series to transfer electricity from point to point, this is prohibited by regulation. Electrical extension cords (16-gauge, 3amp, 3 conductor (prongs), peak surge rating of 1600 watts or more, OSHA & UL listed) are permissible in the 10' x 10' Pit as stated.

Q: Are short "pig tail" or power strip savers extension cords allowed?

A: Yes, if they comply with OSHA & UL listed.

Q: In the 2015 contest teams were not allowed to charge batteries overnight. Will the same rule apply for the 2016 contest?

A: Yes.

Q: Page 11: Working in the Pit. Participants should be wearing approved personal protective equipment, PPE, in the Pit at all times, including: Safety goggles over prescription glasses, or prescription safety glasses that are agency approved. Will safety glasses be required in the aisles?

A: No.

Q: If a team is not doing any maintenance or modification work on their robot, will safety glasses still be required to be worn in the pit area?

A. No.

Q: Page 12: Transporting. "Make sure the robot is secured to the cart to move back to the Robopit." Does this rule mean that the robot has to be tied down to the cart before moving it with rope, clamps, or rubber tie down straps?

A: No. Center the robot and its center of mass so that it will not fall off the cart during transportation, and remember to shout out "R O B O T " in a loud, clear voice to alert all around that you are moving your 'bot.